



## Original research article

## Scales of governance: Translating multiscale transitional pathways in South Africa's energy landscape

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## ARTICLE INFO

## Keywords:

Energy policy

Energy governance

Socio-technical transitions

Actor-Network Theory (ANT)

Scale

## ABSTRACT

In this paper, we argue for a multiscale focus on the governance of energy policy and practice. This perspective reveals the translation of agendas and policies across scales stretching from the global to the local. We analyse South Africa's energy landscape, which is influenced by: a highly complex and dynamic set of generation and production networks, policy strategies, multiple state and non-state actors, and the continuing impact of apartheid. In the paper, we establish a dialogue between Actor-Network Theory and studies of socio-technical transitions to analyse the translation and purification of discourses and practices across scales, and to consider how these processes may impact on spatialised processes of energy transition.

## 1. Introduction

In this paper, we argue that the governance of energy policy and practice needs to be viewed in a multiscale context. This perspective reveals the ways in which differing priorities and agendas are communicated, changed and sometimes obstructed or subverted [1], influenced not only by the scale at which they are generated, but by the interaction between scales and between different actors operating at specific scales or across scales. We focus on the case of South Africa's (SA) energy landscape, which is shaped by a highly complex set of generation and production networks, as well as policy initiatives, state and other actors, and the apartheid legacy [2]. Within the country's energy landscape, our research centres on the electricity supply to households in informal settlements: an important (but often overlooked) energy geography. Our analysis is informed by a combination of two related theoretical approaches: Actor-Network Theory (ANT) and studies of socio-technical transitions. The former enables the paper to analyse how discourses and practices related to energy are dynamically translated and purified between different scales and by different actors. Understanding how processes of translation operate then provides an entry point for discussing the pathways and potential obstacles to the politics of transition [3,4], as well as linking these pathways to spatial processes of transition [5].

The analysis presented below is predicated on an understanding of

energy transition and policymaking processes as multiscale [6,7]. We argue that it is key to consider how energy policy is articulated at various scales, including global, national, municipal, community and household. In the SA context, this perspective is fundamental to how local contexts and needs interface with national concerns and mandates, as well as with global issues such as climate change. At the same time, we recognise that multiscale interactions in governance are shaped by a shifting landscape of actor-networks, from global policy-making arenas to national government and electricity distribution actors, to individual energy producer-consumers (prosumers), and including actors who are excluded or defect from the formal grid [8]. Here, therefore, our analysis is segmented by geographical scale and time. Our aim is to thereby show how discourses around energy are negotiated and performed at several scales, while not reifying scale as a fixed unit of analysis and recognising networks as inherently dynamic. Our conceptual understanding is based on a recognition of the inherent mutability of networks of actors, while also accounting for those aspects (e.g. socio-economic and techno-political structures, infrastructural and other 'lock-ins,' and inertia) of energy landscapes that are part of resistors to change.

Analysis is based on research with multiple actors, including national, provincial and municipal government, activists, energy companies, NGOs, civil society organisations, and researchers. Our methodology is based on discourse analysis of 42 interviews conducted in

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2017–18; analysis of policy documents as well as reports from governmental agencies; and participant observation and observer participation at four energy policy workshops, two held in Johannesburg and Polokwane in 2017 and two held in Cape Town in 2018. Interviews ground a multiscale analysis in the context of one metropolitan city (Johannesburg) and one secondary city (Polokwane), where the municipal governments have created institutional structures and planning processes that address climate change, which engage international donors, national government and NGO representatives. Workshops were convened by South African NGO Sustainable Energy Africa (SEA) and geared toward characterising and addressing multiscale governance of energy and climate change.

## 2. Networks, translation and energy

Our research draws mainly on the policy applications of ANT, while also linking this literature with research on socio-technical transitions. Specifically, we build our analysis on ANT's understanding of modern socio-technical realities (e.g. energy geographies) as networked and unstable, and discursively and materially constructed and performed.

Energy scholars have, over the past decade, integrated the insights of ANT and other branches of the social sciences into energy systems and services research. In recent years, scholars utilised ANT to explore the ways in which dynamic networks of actors form specific societal trajectories [9], or to explore how barriers to socio-technical system changes are constructed through networks based on specific processes of purification and translation. For example, Jolivet and Heiskanen [10] use an ANT framework to show how controversies around wind power development can be interpreted as attempts to reframe energy projects. Additionally, they highlight how energy development projects need to be seen as the result of interactions between globally circulating technologies, the specificities of local energy sites, and social and political processes [10,11].

Central to an ANT-enabled analysis is the notion that issues are understood, presented and challenged according to the twin processes of purification and translation [12,13]. Purification effectively separates knowledge into specific ontological zones [14], such as 'nature' or 'culture'. A simple example of this division is a renewable energy such as wind power. While the socio-technical and infrastructural system of wind power generation and distribution can be seen as purified into the cultural sphere, the element of wind is most often treated as part of the natural sphere. At the same time, the politics of renewable energy mean that wind power landscapes are often purified into 'nature' (especially in cases where opponents of wind power construct it as destroying 'pristine' natural landscapes), or as parts of a rationalised techno-cultural landscape, 'beautiful symbols of modern dynamism' ([10], p. 6750).

Our paper focuses on the concept of translation. In ANT, translation refers to the discursive, technical, scientific and political mechanisms through which issues from different ontological zones can be mixed together. The hybrids that are produced as a result of this ongoing process can take on the function of aligning interests, priorities, and strategic imperatives that previously existed in separate form [15]. Thus, ANT challenges the tendency of modernity to purify reality by focusing on the way(s) in which translation mechanisms produce concepts and 'things' that can be seen *in the process of translation*, thus not belonging to either ontological zone. Indeed, when an idea is considered in the process of translation rather than in purified form, what becomes visible is the (socio-technical, cultural, and political-economic) *network* that constitutes it. Thus, through translation, ideas gain acceptance, as discursive mechanisms translate them into concepts that become widely accepted [16]. At the same time, the process of translation also involves constituting power relations within a network, including defining actors within the network [17], and those who are allowed to speak on specific issues, and *for* silent (or silenced) others in the network.

Translation is relevant to the way policy is framed and implemented at a variety of scales because through translation, certain ideas are 'progressively transformed into facts through the enrolment of people who come to interpret claims and ideas in a way which caters to their own interests' ([17], p. 533). Indeed, Monstadt and Schramm ([1], p. 109) define translation as an 'editing process' that 'creates a new reality in the local context so that the two ends fit each other, and thus a local version of ideals and models is produced.' The translation process has attracted particular interest from energy researchers precisely because it is a part of ANT that can help analyse processes such as transition, approaches to risk, energy policies, and other key issues. In their study of the United Kingdom's quick transition towards natural gas as the main fuel for residential central heating in the 1960s and 1970s, Hanmer and Abram [18] show how translation could be identified as the key mechanism through which actors' interests were aligned and framed, and through which actors were mobilised for an energy transition.

While our approach is rooted in ANT, we make a contribution by linking its multiscale network perspective with research on socio-technical transitions [19–22] and by linking our framework with work on energy transitions in an African [23], specifically South African [24–26], context. We focus on how linking ANT to socio-technical transitions can help understand the spatial and multi-scale processes of translation and change regarding electricity systems specifically, and socio-technical energy infrastructures generally. We make these connections through the analytical framework developed by Murphy and Carmody [27] to study Tanzania's urban transition. Leveraging this work, multiscale networks of electricity provision, consumption and governance appear as socio-technical systems characterised not only by dynamic actor-networks, but by regimes that are 'dynamically stable arrangement[s] of materials, practices, and relations' creating both a logic of change and 'path-dependencies and momentum with regard to the evolution of sociotechnical systems' ([27], p. 135). Murphy and Carmody's framework emphasises these systems as characterised by production, consumption and infrastructure regimes. Production regimes determine locally specific value creation and upgrading activities by service providers. Consumption regimes, whilst overlapping with production regimes, concern the consumption of commodities (such as fuels), basic services (such as electricity allowances) and welfare goods. Lastly, consumption regimes shape and are reshaped by 'infrastructure regimes that supply, invest in, distribute, and regulate essential goods and services' ([27], p. 135), such as electricity. In turn, two key elements holding together these dynamic regimes are governance arrangements and the multiscale relationship between various elements of socio-technical systems. We argue that it is processes of purification and, more directly, of translation, which help to produce and reproduce regimes as ways of making sense of different priorities around electricity supply, by different actors, at different scales.

In summary, the use of ANT helps understand the ways in which multiscale processes of arrangement of energy and electricity systems in SA are organised through mechanisms of purification and translation. In addition, a socio-technical transitions perspective adds depth to the network approach by understanding networks as operationalised through specific regimes, which in turn impact governance and its multiscale expression(s). Furthermore, by drawing on both approaches, we find common ground in both perspectives' interest in how governance is *spatially* articulated [28], and in how networks are dynamic and exhibit permanence at different scales over time [29]. Finally, by drawing on a transitions perspective informed by ANT and linking it with the SA multi-scale energy landscape, the paper contributes a novel approach to the wide range of studies [2,8,25,26] that have thus far explored the SA energy landscape and its potential for transition and change.

In the case of energy transitions in SA, therefore, we argue that ANT provides useful insights into how any required large-scale and multi-scale change is 'not straightforward: it involves adjustments to many

aspects of a self-reinforcing system, such as cognitive routines, design criteria, regulations and standards, markets, sunk investments and competencies' ([30], p. 6121). In turn, the actors in networks at each scale coordinate these adjustments: some networks operate at a variety of scales, and some across scales [31]. As Murdoch and Marsden [32] argued, networks of political and other actors engaged in processes of change at different scales often give rise to layered outcomes in terms of the interaction between structural determination and more specific contingent contexts as expressed in socio-spatial relations. ANT can be helpful precisely for the purpose of 'investigating links between energy systems and political structures at national scale as well as household and local levels' ([18], p. 182). In addition, we consider the international scale, where SA national actors (e.g. the government) play a key role in translating global policy imperatives to municipal and local scales while making sense of local realities for a global policy audience. As Siakwah [33] has argued in work that uses ANT to explore conflict around oil in Ghana, considering the global scale is a useful way of avoiding 'methodological nationalism' ([33], p. 68) when considering actor networks.

### 3. Multi-scalar energy governance: The South African context

SA's energy system is complex, and issues around energy transitions are present at various levels. In turn, the interplay between the different scales at which governance takes place and is communicated determines transitional pathways and helps to influence changes at a regime level. The following outlines the governance context within which energy pathways are being fashioned and inter-scalar processes are operationalised.

The country's governance is based on a three-tier system consisting of national, provincial and local government, and in each a range of stakeholders are involved. National government creates laws and policies that govern distinct but overlapping aspects of energy governance, including climate change policies (e.g. *The National Climate Change Response Policy White Paper*, 2011), resource planning (*The Integrated Resource Plan (IRP)*, 2019) and national development plans (*The National Development Plan*, 2012). Of crucial importance to understand the national scale in multi-scalar energy governance in SA is the role of Eskom, the national electricity utility, and the wider electricity planning context [34]. Eskom is a state-owned enterprise that owns and maintains the national grid, manages all imports and exports of electricity and has a near monopoly over SA's electricity generation [35]. Eskom has also historically carried out electricity planning. Powers for the Department of Energy to conduct an open planning process for electricity were only established in the Electricity Regulation Act (2006). The country's first public electricity plan, the Integrated Resource Plan (IRP), 2011, delivered both a new institutional process and the potential for a fundamental break with the long-standing coal-dependent electricity system [36]. The plan was the first integrated and participative strategy for mapping pathways towards future electricity generation scenarios, and enshrining them into policy [37]. Regarding transitioning away from coal, the IRP's 2010–30 scenario projected adding 6.3 GW of coal power capacity, but also 17.8 GW renewable capacity (focused on solar photovoltaics, or PV, concentrating solar power, or CSP, and wind), 9.6 GW of nuclear capacity, and 8.9 GW of capacity from other sources (including imported hydro power) [38]. However, critics argue that successive iterations of the IRP have constrained renewable energy growth, assuming significantly higher costs for wind and solar power than those achieved in recent auctions. Scholars and others have argued that despite initial gains in the transparency of energy policy-making, the stalling of recent versions of the IRP signal a return to highly secretive decision-making characteristic of energy policy under apartheid [37] that consolidates energy planning as a national competency and privileges fossil fuel incumbents including Eskom [38–41].

SA's nine provinces are limited in power by their reliance on

national government for financial transfers to implement policies. Although overarching legislative powers reside with the national government, the objectives and developmental duties of local governments are set out in the Constitution. These include access to services for all, prioritising the poor and socio-economic development. Local governments play a crucial role in delivering energy services and have a range of local-level policies focused on energy and climate change. This role includes maintaining the infrastructure, connecting new customers, and setting pricing and subsidy levels for low-income consumers [42]. Electricity distribution is one of the key roles of SA's municipalities. While Eskom is responsible for 60% of electricity distribution, municipalities are responsible for the remaining 40%. Importantly, the revenue that municipalities gain from their electricity sales is used to cross-subsidise the provision of other basic services, as well as connections for low-income households [43,44]. Until recently, the municipal level had been largely overlooked in policy analyses of SA's electricity sector. This has changed in recent years with the political significance of climate change, frustrated electricity sector reform, and an electricity supply crisis, which have spurred large urban municipalities to reassert and expand their role in energy governance, creating tensions in multi-scalar governance.

While broader structural and political issues are key to how energy policy is translated across a range of scales including the national and municipal scales, it is at the community and household levels that the negative consequences of the current energy supply and distribution system are most keenly felt. SA faces significant, continuing energy access challenges: 47% of the population is energy poor [36]. Although most SA households are connected to electricity, many still lack access to electricity or clean cooking fuels. Following the democratic transition, the Integrated National Electrification Programme (INEP) saw a dramatic rise in domestic connection rates with 87% of households connected to the grid by 2012 [45]. This success was assisted by surplus generation capacity and low electricity prices. As many households cannot afford to use the electricity to which they are connected, despite a basic allocation of free electricity, access to electricity is not reflected in electrification rates and millions of low-income households remain dependent on energy sources such as paraffin, wood and coal. This leads to problems such as air pollution, respiratory illness and shack fires [46]. Furthermore, by the early 2000s, progress in the national electrification programme had slowed, partly due to issues such as the additional infrastructure required to connect sparsely populated rural areas [47], the growth of informal settlements. Additionally, the legacies of 1948–94 apartheid era planning inhibited electrification: Black, Indian and Coloured populations were segregated into townships and informal settlements (Group Areas Act of 1950), which were usually located on city outskirts with poor public transport connections and minimal public services. Planners were involved in the siting and layout of these informal settlements. Electricity was mainly supplied to the White population only, which left other, segregated, populations living in non-serviced townships and informal settlements. The apartheid regime left a substantial proportion of the population without electricity, and post-1994 development and planning policy has tended to reinforce apartheid-era spatial patterns.

### 4. Translating energy policy in a multiscale context

As described, we focus is on how translation occurs in a context involving multiple scales of governance. We aim to trace how discourses around priorities at different scales are modified so as to make sense to specific networks of actors operating at the same or different scales. For example, at the national scale, governments seek to pursue energy policies that speak to global audiences while translating global imperatives for city governments and state and municipal authorities. These same city authorities and government departments are then the interface between communities, households, and the national and international policymaking dimension. Thus, the energy policies with

which municipalities are concerned may be directly linked, through national government, to global priorities, but the way(s) in which they are debated and presented differs *because* translation of policy discourse and imperatives becomes necessary by different scalar actors. In focusing on translation across scales and through networks of actors, we draw on long-standing calls from scholars for research that is both sensitive to scale and for work that avoids adopting a single institutional or organizational analytical focus [48]. The paper focuses on a broad network of scalar governance that impacts the energy landscape and its materialities at the local scale, stressing that the configuration of scales of governance should not be seen as a strict top-down hierarchy, but as a dynamic power geometry [49,50]. Indeed, the scales of governance outlined below do not necessarily interact in a linear fashion: specific cities, for example, can be seen as crucial actors when reporting for sub-national climate actions is involved: this reporting, in turn, is crucial to national performance seeking climate finance from the international community [51].

We highlight various scales of governance while focusing more specifically on what we consider to be oft-ignored scalar realities in sustainable urban development: the community and household scales. This focus aims to conceptually hold together different scales and governance processes that can be described as a network. Following Dicken et al. ([48], p. 91), we understand networks as ‘essentially relational processes, which when realised empirically within distinct time- and space-specific contexts, produce observable patterns in the global economy.’ We argue that the patterns produced by actor-networks at the municipal, community and household scales are visible throughout SA’s national energy landscape, especially when considering specific configurations that lead to energy inequalities in the context of housing informality. Thus, the analysis below includes a focus on the household and community scales, while situating these within broader relational networks of actors and processes across and within other scales of governance. Focusing on household and community scales can imply potential biases of speaking to broader processes from the starting point (s) of specific geographical and actor contexts [48], but it is in the household context that SA’s so-called ‘energy underclass’ ([2], p. 1) is expressed in individual biographies [52–54]. Thus, how these scalar actors are enrolled in and shape transition pathways is important empirically, conceptually and in policy practice.

First, much of the work on the household scale and environmental governance (see, for example, [55–57]) has been in developed contexts characterised by techno-economic interventions into cities where basic material needs are largely met. Similarly, analysis of the potential for urban experimentation to identify practices for sustainable urban development [58,59] has tended to ignore Global South urban contexts. There is much scope for widening this research agenda [60]. Second, equity and justice can be served by inclusive planning, multi-institutional network-building, and multi-scalar translation of policy and community-based adaptation strategies [61,62]. This body of research underlines the key importance of the community level, and we extend this consideration by arguing that the household scale should also benefit from research emphasis. From an ANT perspective, the key question is to what extent planning for inclusive transitional pathways manages to enrol a diverse range of actors (including local and commonly excluded actors). Third, we argue that a focus on community and household scales is key in that it helps to move towards the right to the city [63] in a local context where rights may be enshrined in law but are bypassed in practice. Thus, a focus on community and household scales can be part of a process of opening up the right to the city and to full citizenship [64]. By citizenship, we signify not only the rights and duties of current citizens [65], but the situations of individuals who aspire to gain SA nationality [66,67]. Finally, this approach helps to spatialise discussions – on topics such as the circulation of global energy and sustainable development policy [68], transnational climate governance and adaptation [69], energy and cities in the Global South [70] – that often focus on the national and supra-national scales. A focus on

communities and households necessitates, by definition, grounded engagement with the *places* and *people* impacted by processes of energy provision (or lack thereof).

## 5. Multiscalar perspectives and energy policy

Our research highlights processes of translation of priorities related to energy policy that are articulated across a range of scales. In turn, actor-networks with differing levels of agency at different scales perform the SA energy policy and practice landscape, at a specific scalar level (such as the national policy landscape) as well as framing and communicating energy issues and trajectories to actors at different scalar levels. In the following discussion, we highlight this process of translation of different imperatives within and across scales and by different actors: this shows how energy governance is affected by translation of policy and practice through different scales of governance. While context is key, our focus is on how translation works, and is expressed, by different actors at different scales. In addition, we aim to show the implicit constraints within scalar energy governance, as specific priorities at one scalar level are changed or at times subsumed into more diffuse or different narratives depending on the type of framing used.

### 5.1. The global scale

At the global scale, SA national energy and development priorities interface with the circulation of policy discourses and priorities such as UN climate change agreements, requirements for accessing climate finance, and in international action on emissions, green growth and other issues. Like other states, SA has been involved in international climate and sustainable development negotiations, including the 1992 United Nations Framework for the Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Climate Agreement. SA’s international commitments are tempered by recognition that ‘any policy-driven transition to a low carbon and climate resilient society must take into account its overriding priority to address poverty and inequality’ ([71], p. 2). Previously, SA’s emissions reduction commitments at the 2009 Copenhagen Climate Summit had demonstrated a gap between national government and the corporate and local scales. President Zuma framed South Africa’s emissions target as an emissions *intensity* target, gaining international praise without committing to a target for absolute emissions. Nonetheless, the proposed action was also described as being ‘totally at variance with what is taking place in SA on the ground as regards energy and it disregards the country’s lack of ability to implement the curbs without damaging the economy, especially given its reliance on coal fired power’ ([72], p. 6). Even at the scale of supra-national environmental discourse, clear constraints exist when globalised discourse(s) are communicated to national-scale actors who, while needing to communicate with international policymakers, are also aware of local contexts of energy poverty and inequality, uneven economic development, and structural constraints.

A set of transnational ideas are also translated into local social and sectoral context by municipalities and NGOs. Policy experiments with universal basic income in European countries have provided inspiration for innovation in municipal energy policy in Cape Town. A municipal team responsible for low income energy services proposed that reimagining electricity supply as a variant on basic income might lever wider political support to increase subsidies for residential electricity use:

“Electricity is extremely versatile – it’s the next best thing to money. You can do so many things with electricity... Universal basic income has had a radical impact on poverty elsewhere. Electricity is the next best thing, and the City has total control over it – it’s something that we can provide.

The proposal emphasised benefits that could enrol other municipal



and national actors, including positive effects on health (by displacing unsafe cooking fuels), nutrition (by enabling electric cooking at home), and connectivity (enabling social inclusion through television and internet access). They emphasised that affordable access would deter electricity theft that contributes to municipal debt, and expressed Keynesian ideas that affordable access would increase consumer demand, serving the local and national economy:

“We’re giving the wrong message to poor households – saying ‘save electricity’; they’re not even vaguely using enough... And no-one can object on the basis that the poor will waste it”

“And so this is about the total finance system in the City and in the country. So how do we make it make sense that we pay for this?”

The proposal was accompanied by quantification of an estimated reduction in the city’s Gini coefficient, a statistical measure of inequality with the power to name Cape Town among the most unequal cities in the world and to draw international attention to failures in addressing the structural legacies of apartheid.

Global or transnational ideas are also translated as they are localised by advocacy groups. A South African NGO described how their efforts to frame a campaign for localised control of the energy system encountered confusion locally. Inspired by food sovereignty movements in Latin America, the NGO had convened workshops on ‘energy sovereignty’ to emphasise community control over how energy is produced, traded and consumed. Yet, they found that sovereignty was too closely associated with the state in a South African context and had little traction with grassroots activists, while ‘energy democracy’ held more positive connotations. Similarly, various civil society forums on energy transition adopted the language of ‘Just Transitions’, where the democratic transition is recognised to have left racial and socio-economic injustices unaddressed, and where the question of ‘what to do about coal jobs’ frames discussion about decarbonisation and the prospect that labour unions might provide meaningful support for social movements on climate change.

## 5.2. The national scale

At the level of national government, energy is an issue that becomes translated in multiple ways depending on whether dialogue is taking place within national government, with international institutions and other governments, or with municipalities. Simultaneously, energy discourse(s) at this scale are complex assemblages made up not only of dynamic actor-networks, but of narratives and policy agendas that can be disaggregated by different types of energy. For example, household energy is generally segmented into its purposive use (for lighting, cooking, heating and sometimes transport).

Discursive work with international actors necessitates the translation of national imperatives (for example, eliminating energy poverty and other forms of poverty) into action on global concerns, usually climate change. When the national scale interacts with municipalities, on the other hand, what is brought to bear is less the international climate change imperative and more the need to fulfil constitutional commitments to end poverty and enable energy access for all, and the implementation of national energy policy. At the same time, the national scale is where specific network tensions are expressed. A key example is the scalar tension in electricity distribution, between local municipalities as and Eskom as a vertically integrated company. In Johannesburg both distribute electricity to different supply areas, which derive their form from apartheid era spatial planning and subsequent institutional reform. Crucially, the municipal distributor, City Power, must extract a surplus from their customers to fund municipal budgets, but Eskom does not. As a municipal energy manager in Johannesburg explains, this scalar disjuncture in electricity governance creates inequalities for residents and businesses:

“Sandton and Soweto [in Johannesburg] are supplied by Eskom and

the rest of City of Joburg is City Power. [...] So ironically, somebody in a low-income area in Joburg is cross-subsidising someone from a low-income area in Sandton or Soweto. Net result? Electricity in a municipal area is not as affordable as in an Eskom area.”

However, there is also an element of purification: of issues as they pertain to diverse audiences, and at different scales. The common denominator (electricity) becomes purified into an economically problematic, poverty-facing ontological zone (symbolised by Eskom supply), and contrasted with a more stable, legitimised zone (municipal energy supply). Thus, the interaction between the national and international scales tends to purify the issue of energy poverty into one of climate change adaptation and mitigation, and into one of binary actors distributing energy to the poor.

An example of the above dynamic can be seen in SA’s 2017 Climate Change Adaptation Strategy, authored by the Department for Environmental Affairs [73]. The strategy clearly maps the international landscape around climate change adaptation and mitigation, and points to the opportunities for support and monitoring available through international arrangements. At the same time, when considering the sub-national scale at the level of municipalities, the strategy highlights how ‘climate change response capacity is extremely limited in the provincial sphere of government’ ([73], p. 40), an ironic point when considering that provincial government relies on national government financial transfers to implement these policy goals. Nonetheless, in a discursive move back to the national scale, having established the limitations that exist at the level of municipalities, the strategy then places the emphasis back on the local scale by stating that: ‘The broader mandate for local government to respond to climate change is rooted in SA’s Constitution, because many critical actions required for climate change responses fall within the responsibility of local government’ ([73], p. 82).

The example of SA’s Climate Change Adaptation Strategy shows how national government is situated at the interface between national priorities around equity and energy, and international discourses on global issues such as climate change. At the same time, the strategy highlights the translational issues in transforming climate change action into local priorities, and the scalar complexities involved. These translational complexities can, in turn, be felt as a disjuncture in translation between the national and local scales of governance. A Johannesburg-based activist provides a critical self-reflection on the extent to which climate campaigners have managed to translate climate change into something that resonates with immediate social and environmental concerns that evoke popular discontent:

‘[W]e have not connected issues like climate change to everyday struggles ... On the ground, there isn’t an environmental justice movement, a connection between things happening in different places. And the service delivery strikes – the protests – are more complex than simply environmental justice.’

What is key is the notion of distance between local priorities and national agenda items such as climate change. The quote evidences a purification of issues into different ontological zones: in this case, into a global and long-term zone (climate change), and a local and everyday zone (energy poverty). This particular distinction is also an example of purification of specific issues into different scalar and temporal zones. However, the core of the activist’s argument is a desire to see a *translation* of these issues from the global and local zones, to be considered at a point of hybridity where the two become intertwined.

## 5.3. The municipal scale

The issue of municipal financing also highlights the translational difficulties between national policy and local contexts. At a workshop on climate finance for municipal government, a consultant who had advised National Treasury on mainstreaming climate change into municipal planning reflected that the Treasury is insistent that

municipalities look to the international scale to fund infrastructure for climate adaptation:

‘There are real limits to what can be done by maximising the intergovernmental grant system. National Treasury want local government to be more financially resilient, so they need to be using their own sources of funding... So then you have to start thinking about accessing the Global Climate Fund. Kigali has got it, so why haven’t South African cities?’

Municipalities often cite the Municipal Finance Management Act as a barrier to effective climate action, since it limits the temporal and scalar power of municipalities in borrowing, procurement, and long term planning that they may need to raise capital from international markets or meet the high capital expenditure of actions that offer transformational change. Consultants that drafted a discussion paper for the workshop suggested that municipalities might exercise some agency within the constraints imposed by the law by interpreting it differently:

‘...often institutionalised interpretations of the provisions are not the only way to interpret the Act within legal bounds. Reinterpretation is very important, as an overhaul of the regulatory framework is not well supported [by national institutions].’

During the same workshop, municipal representatives spoke of the challenges and contradictions of translating local government into the programmatic climate action that is legible for climate finance monitoring and verification, while simultaneously speaking to national priorities on competitiveness, inequality and unemployment:

‘We’re always under pressure to create jobs. But to make the argument is very difficult. It’s empty in some ways. We can try to show how money can circulate in the local economy, so the city is not throwing money outside the city... I can directly argue for that. But for the jobs stuff, I make it up as I go along.’

Similarly, there is recognition that smaller municipalities may have to combine actions and increasing coordination, possibly creating special purpose vehicles (SPVs) for infrastructure investment in order for climate action to be legible to investors at national and global scale:

‘There is lots of money sloshing around in South Africa with institutional investors, but they don’t want to invest it with municipalities because they don’t understand them. Pooling Green Bonds allows you to access them.’

While municipalities are encouraged to translate local priorities into programmatic climate action that is legible at the global scale, they are under pressure to ensure that they are delivering services locally and accountable to residents rather than global institutions. One municipal employee noted how this dynamic shaped party-political competition between mayoral candidates in Johannesburg:

‘[Mayor] Parks Tau was accused by some of promoting vanity projects at home... and for self-aggrandising on the international stage with the Ecomobilities event ... The current mayor says he has no interest in UN-Habitat or those international city networks. He says he’s more focused on service delivery.’

Yet, the same interviewee notes how party-political change and even municipal strategy may be partially isolated from how the city’s bureaucracy operates in practice:

‘For all the struggle over changing the strategy documents when the DA [Democratic Alliance] came in – like changing the IDP [Integrated Development Plan], or discussions around ditching the Corridors of Freedom – I still know what I have got to do. I deliberately did not attend those meetings about strategy’

Where intergovernmental transfers are restricted and accessing climate finance is onerous, South Africa’s largest city municipalities have

sought debt finance through Green Bonds. The City of Johannesburg’s first Green Bond was oversubscribed; it was considered as a possible model for financing the City’s own investments in renewable energy generation that could directly challenge Eskom power as the single buyer of electricity from independent power producers. In Cape Town, one municipal manager cited problems with the city’s own bond: ‘Green Bonds are very effective in raising money, but it’s expensive money because it’s refinancing existing projects’.

#### 5.4. The community scale

At the community scale, the complexity of actor-networks involved in SA energy generation, distribution and consumption is evident. The community scale is where national authorities act, sometimes directly or through local intermediaries, while being the interface where households and community organisations interact with different municipal government departments. At community level, for example, Ziervogel et al. [74] have shown how flood risk affecting informal settlements in Cape Town can best be understood through the study of ‘nodes’ of governance in local government. These ‘nodes’ are the different departments, and their differing ‘mentalities’, within a single local government authority. Ziervogel et al. [74] underline how unpacking the way(s) in which governance plays out through these at times siloed nodes, and then at the community level, is key to understanding both how approaches to specific issues (such as energy access) are influenced by different mentalities and technologies enshrined in different government departments, and how obstacles to resolving ingrained problems (such as equitable and affordable energy access) can be tackled through a reconfiguration of these nodes. At the same time, it is clear that (as with other multiscale interactions) links between communities and other scales of governance are effected through complex translation arrangements. The complexities of translation between various scales of governance are evident in the growth of power generation by residents and businesses, and how it contrasts with existing energy governance. These complexities are reflected in the following quote by a representative of the local government association, SALGA:

‘In the city we see a lot of contribution [to electricity generation] from the customers... We see a lot of private investors in the local government space... And at national level, it’s still vertical integration, centralised planning, big infrastructure. It’s going to increase the electricity price and it’s unclear if we need it at this time.’

The same interviewee further explained how the local, municipal level had, in their view, been somewhat illegible from the national scale in terms of translation of national imperatives to the municipal scale, and the community scale to the national:

‘[N]ational planning looked at local government as a black box in their planning and didn’t take into account the dynamics, and the developments that are happening and there’s a lot happening.’

This insight is evidenced in debates around municipal production of energy. Utility-scale IPPs of electricity from renewable energy and coal were recently introduced following the launch of the country’s REIPPPP and a subsequent programme to procure electricity from IPPs of coal [75,76]. Since the start of the programme in 2011 and until the time of writing in 2019, REIPPPP procured approximately 6,422 MW capacity from 92 large independent power producer (‘IPPs’) and 99 MW capacity from 20 small scale (1–5 MW capacity) IPPs. A subsequent programme for the procurement of privately generated coal-fired power was introduced in 2015 [41].

However, some factions of government and some trade unions see the introduction of renewable electricity generation as a direct challenge to the monopoly control of Eskom, and to employment in coal mining and coal-fired power plants. Eskom has been structured around its dependence on ‘big coal, big nuclear, big networks’ ([77], p. 1) and

continues to rely on mega-projects, most recently the coal-fired power plants Medupi and Kusile, currently under construction. The utility has long been resistant to the diversification of its sources of electricity generation as well as attempts to liberalise it in line with international trends in power sector reform, both of which would pose a challenge to its monopoly control. In February 2019, it was announced that Eskom would finally be split into three separate companies under Eskom Holdings, for generation, transmission and distribution with each entity having its own balance sheet. This would see the single biggest economic reform since the democratic government restructured public finances in the late 1990s.

Those at the community scale question why Eskom cannot be re-conceptualised as a national entity that can be charged with energy diversification and with more local provision. As a union worker in Johannesburg stated regarding the argument that Eskom's power plants closure was due to IPPs:

'On the recent announcement of the closure of coal plants ... There's a contradiction. The reason Eskom has given for closing them is the IPPs. The main problem is surplus caused by the IPPs. Eskom resisted signing off on new IPPs over the last year and the government forced them to.'

The quote highlights a tension between national-scale actors (Eskom, the national government) and municipal-scale stakeholders. At the same time, the same interviewee highlighted how this issue, being debated at national level, was of key concern at the community scale because of local economic realities involving the current energy system:

'With closures, communities will collapse, [towns] will become ghost towns, dependent on the power stations. [T]here should be no power station closures. And we've combined with Eskom to discuss with government. We support renewables, but we don't support IPPs. We don't understand why Eskom can't participate in the renewables. If it was a publicly owned and socially owned entity for renewable energy then [the union] would support it. There is no effort to maximise job creation.'

Divesting from coal has become a strongly politicised (and racialised) issue due to the coal industry providing significant employment, and union resistance to divestment. Coal accounts for c.72% of SA's primary energy, and the energy sector is responsible for the majority of SA's GHG emissions [78]. This constitutes a significant transitional challenge in light of policy aims to move towards a sustainable, low-carbon economy. Decentralisation and the diverse realities of different municipalities and their energy needs were also issues that highlighted the disjuncture between national-scale planning for energy distribution and local realities, according to the same SALGA interviewee as quoted above:

'[D]emand in the city is going to grow, and it's needed for services and everything but the way we meet those needs will be very different. Not only electricity from national grid but also energy that is locally produced. Also there will be other sources, mainly gas. And that's where the national planning isn't looking at those dynamics.'

In addition, decentralisation of electricity generation and the potential of small scale generation through technologies such as PV were seen in part as holding great potential precisely because of the promise to, on the one hand, overcome obstacles such as legal and economic difficulties in electrifying informal settlements and, on the other, provide technological solutions that are local and seemingly not as dependent on municipal or national scales of governance for their roll-out or operation. One such project involves installing household solar PV systems in an informal settlement in Stellenbosch. The managers emphasised that a critical factor in the initial success of the project was assuring residents that a solar home system would not undermine recognition of tenure or delay the extension of grid supply to their homes, but that solar would only be a temporary solution, 'while you wait' for

the grid. Other approaches raise similarly contentions, such as those under consideration in Johannesburg, described by a municipal employee:

'projects such as a solar facility in informal settlements, perhaps on a shipping container where people can come and charge their phones, or which connects to 10 or 20 households. Something that is self-contained, not drawing on the grid, which can be managed by the community themselves, to own and maintain it, not the City. Like an independent microgrid. We don't want them touching the formal grid, because it's still a strain on the formal grid. It's all very well to say connect those people, but they are still drawing legally and illegally from the formal grid. It needs to be off-grid, completely, self-sufficient, self-contained, managed by the community.'

The above quote clearly points to the complex controversies surrounding the issues of connecting informal settlements to a universal grid network or, alternatively, supporting (or allowing for) private sector actors in developing non-grid-connected systems for the provision of electricity. Additionally, these difficulties present a spatialised transitional challenge. These types of controversies herald potential scenarios where specific areas of the country become enrolled in transition towards future energy scenarios, while leaving other areas and societal groups behind.

## 6. Discussion and conclusion

It is clear, from the above analysis, that SA's energy policy and practice landscape is highly complex and dynamic. At the same time, it is sometimes discussed as rigid and locked into a system of national energy service and infrastructure provision that seems monolithic and largely inefficient. The dynamic nature of the country's energy landscape is seen when a conceptual lens informed by ANT is deployed. What comes into focus is a shifting pattern of agency, power, and actor-networks active at different scales, from the resident of an informal settlement reliant on burning fuel all the way to the global policy-making arena where energy is translated into a sphere of action for meeting emissions and other sustainability targets in light of the climate change imperative. Rather than reifying different scales of energy governance and presenting them as fixed and determined, a focus on translation shows how discourses are mobilised, framed, changed, sometimes dissipated, and communicated at and between different scales. In turn, this insight is key to understanding the mechanisms through which energy priorities, by different assemblages of actors, can be enrolled into trajectories of transition towards more equitable, just and sustainable energy landscapes [79]. The paper has argued that combining insights from ANT and studies of transitions contributes to energy research through this highlighting of mechanisms of translation that are key to envisioning and enabling transitional pathways. Indeed, it could be argued that identifying translational processes, as well as obstacles to translation (such as the siloisation and single-department focus outlined above), is a key initial condition to the elaboration and eventual operationalisation of energy transitions.

In addition to the reflections and analysis above, it is also clear that, in terms of multiscale energy governance, the (poorest) household and community scales seem to be under-considered and under-represented in the SA context. The neglect of the community scale is unsurprising in the broader context of widespread and marked inequalities across different aspects of environmental, political, infrastructural and other spheres of life in SA [80]. Nonetheless, from an ANT perspective, the permanence of energy inequalities affecting large swathes of poor or informal households unmasks the fact that the issue of equitable energy access in SA is, at its very heart, controversial, where 'controversial' is understood, from an ANT viewpoint, as a state of socio-technical complexity [81]. This can be seen by the fact that, although actor-networks at all scales easily agree on the priority of energy access for all and of climate change mitigation, when the *complexity* of energy, access



issues, and multi-scalar governance are taken into account, the issue becomes controversial. It is at this point that the household and community scales become key for researchers and policymakers. We argue that this risks eliminating households and local communities from the discourses of power that enable different energy scenarios and that determine transitional pathways. This exclusion is because controversies, such as those around how to deliver equitable energy access to SA's poorest, are at their essence 'struggles to conserve or reverse social inequalities' ([81], p. 262). At the same time, our research clearly points to the key role that municipal actors can play in communicating and putting into action specific transitional pathways. Municipalities are also situated in parts of the network that interface particularly closely with the community and household scale, and municipal actors can have the agency of potentially speaking for communities and households, or of functioning to effectively silence their voices because of specific interpretation of municipalities' role as network spokespersons.

With regards to clean energy transitions, our paper points to the potential for enrolment of communities and households in the poorest areas of SA's cities in managed transitional pathways. While enrolment into a network focused on transition can occur in ways that treat the poor as voiceless actors and makes assumptions about their priorities, it can also happen in more progressive, communicative ways as a result of processes that focus on intermediated engagement between actors in different parts of the transitional network, and in ways that render explicit (and perhaps open to contestation) the power relations that are bound to exist in such processes. What might this mean for SA's poorest urban communities? A range of policy directions could be imagined, from the formation of off-grid, but serviced, settlements with a clear interim mandate, to the recognition of settlements' *settled* status through a translational mechanism whereby communities, municipalities, government departments and the private sector work to establish context-sensitive pathways *in situ* with communities. This would not only help to move towards equitably enrolling communities and households into transitional pathways, but would also help to continue recognising, establishing and respecting household and community status in broader planning trajectories.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Acknowledgements

The research presented in this paper was supported by the Economic and Social Research Council (Grant number ES/N014138/2).

### References

- [1] J. Monstadt, S. Schramm, Toward the networked city? Translating technological ideals and planning models in water and sanitation systems in Dar es Salaam, *Int. J. Urb. Region. Res.* 41 (2017) 104–125, <https://doi.org/10.1111/1468-2427.12436>.
- [2] S. Essex, J. de Groot, Understanding energy transitions: the changing versions of the modern infrastructure ideal and the 'energy underclass' in South Africa, 1860–2019, October, *En. Policy* 133 (2019), <https://doi.org/10.1016/j.enpol.2019.110937>.
- [3] S. Hedden, Gridlocked: a long-term look at South Africa's electricity sector, *Inst. Secur. Stud. Papers* 15 (2015) 24 (accessed 7 July 2020), <https://issafrica.org/research/papers/gridlocked-a-long-term-look-at-south-africa-electricity-sector>.
- [4] A. Smith, A. Stirling, The politics of social-ecological resilience and sustainable socio-technical transitions, *Ecol. and Soc.* 15 (1) (2010), <https://www.ecologyandsociety.org/vol15/iss1/art11/> (accessed 7 July 2020).
- [5] R. Raven, J. Schot, F. Berkhout, Space and scale in socio-technical transitions, *Environ. Innov. Soc. Transit.* 4 (September) (2012) 63–78, <https://doi.org/10.1016/j.eist.2012.08.001>.
- [6] D. Evensen, R. Stedman, Scale matters: variation in perceptions of shale gas development across national, state, and local levels, *Energy Res. Soc. Sci.* 20 (2016) 14–21, <https://doi.org/10.1016/j.erss.2016.06.010>.
- [7] T.L. Muinzer, G. Ellis, Subnational governance for the low carbon energy transition: mapping the UK's 'Energy Constitution', *Environ. Plan. C: Polit. Space* 35 (7) (2017) 1176–1197, <https://doi.org/10.1177/2399654416687999>.
- [8] L. Baker, J. Phillips, Tensions in the transition: the politics of electricity distribution in South Africa, *Environ. Plan. C: Polit. Space* 37 (2019) 177–196, <https://doi.org/10.1177/2399654418778590>.
- [9] C.M.L. Wong, Assembling interdisciplinary energy research through an Actor Network Theory (ANT) frame, *Energy Res. Soc. Sci.* 12 (2016) 106–110, <https://doi.org/10.1016/j.erss.2015.12.024>.
- [10] E. Jolivet, E. Heiskanen, Blowing against the wind—an exploratory application of actor network theory to the analysis of local controversies and participation processes in wind energy, *En. Policy* 38 (2010) 6746–6754, <https://doi.org/10.1016/j.enpol.2010.06.044>.
- [11] A. Nadaï, "Planning", "siting" and the local acceptance of wind power: some lessons from the French case, *En. Policy* 35 (2007) 2715–2726, <https://doi.org/10.1016/j.enpol.2006.12.003>.
- [12] B. Latour, *We Have Never Been Modern*, Harvester Wheatsheaf, Hemel Hempstead, 1993.
- [13] B. Latour, *Science in Action*, Harvard University Press, Cambridge, MA, 1987.
- [14] S. Eden, S.M. Tunstall, S.M. Tapsell, Translating nature: river restoration as nature-culture, *Environ. Plan. D: Soc. Space* 18 (1) (2000) 257–273, <https://doi.org/10.1177/026377580001800101>.
- [15] M. Callon, Some elements of a sociology of translation: domestication of the scallops and the fishermen of St. Brieuc Bay, in: J. Law (Ed.), *Power, Action, and Belief: A New Sociology of Knowledge*, Routledge, London, 1986, pp. 196–223.
- [16] R. Jupe, W. Funnell, Neoliberalism, consultants and the privatisation of public policy formulation: the case of Britain's rail industry, *Crit. Perspect. Account.* 29 (2015) 65–85, <https://doi.org/10.1016/j.cpa.2015.02.001>.
- [17] Y. Gendron, R. Baker, On interdisciplinary movements: the development of a network of support around Foucaultian perspectives in accounting research, *Eur. Account. Rev.* 14 (2005) 525–569, <https://doi.org/10.1080/09638180500041364>.
- [18] C. Hamner, S. Abram, Actors, networks, and translation hubs: Gas central heating as a rapid socio-technical transition in the United Kingdom, *Energy Res. Soc. Sci.* 34 (2017) 176–183, <https://doi.org/10.1016/j.erss.2017.03.017>.
- [19] F.W. Geels, Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study, *Res. Policy* 31 (2002) 1257–1274, [https://doi.org/10.1016/S0048-7333\(02\)00062-8](https://doi.org/10.1016/S0048-7333(02)00062-8).
- [20] F.W. Geels, Understanding system innovations: a critical literature review and a conceptual synthesis, in: B. Elzen, F. Geels, K. Green (Eds.), *System Innovation And The Transition To Sustainability: Theory, Evidence And Policy*, Edward Elgar, Cheltenham, 2004, pp. 19–47.
- [21] F.W. Geels, J. Schot, Typology of sociotechnical transition pathways, *Res. Policy* 36 (2007) 399–417, <https://doi.org/10.1016/j.respol.2007.01.003>.
- [22] J. Markard, R. Raven, B. Truffer, Sustainability transitions: an emerging field of research and its prospects, *Res. Policy* 41 (2012) 955–967, <https://doi.org/10.1016/j.respol.2012.02.013>.
- [23] Y. Sokona, Y. Mulugetta, H. Gujba, Widening energy access in Africa: towards energy transition, *En. Policy* 47 (2012) 3–10, <https://doi.org/10.1016/j.enpol.2012.03.040>.
- [24] L. Baker, Renewable energy in South Africa's minerals-energy complex: a 'low carbon' transition? *Rev. of Afr. Polit. Economy* 42 (2015) 245–261, <https://doi.org/10.1080/03056244.2014.953471>.
- [25] L. Baker, P. Newell, J. Phillips, The political economy of energy transitions: the case of South Africa, *New Polit. Economy* 19 (2014) 791–818, <https://doi.org/10.1080/13563467.2013.849674>.
- [26] M. Swilling, J. Musango, J. Wakeford, Developmental states and sustainability transitions: prospects of a just transition in South Africa, *J. Environ. Policy Plan.* 18 (2016) 650–672, <https://doi.org/10.1080/1523908X.2015.1107716>.
- [27] J.T. Murphy, P. Carmody, Generative urbanization in Africa? A sociotechnical systems view of Tanzania's urban transition, *Urban Geogr.* 40 (2019) 128–157, <https://doi.org/10.1080/02723638.2018.1500249>.
- [28] F. Caprotti, N. Harmer, Spatialising urban sustainability transitions: eco-cities, multilevel perspectives and the political ecology of scale in the Bohai Rim, China, in: N. Frantzeskaki, V. Castán Broto, D. Loorbach (Eds.), *Urban Sustainability Transitions*, Routledge, London, 133–147.
- [29] J. Murdoch, The spaces of Actor-Network Theory, *Geoforum* 29 (1998) 357–374, [https://doi.org/10.1016/S0016-7185\(98\)00011-6](https://doi.org/10.1016/S0016-7185(98)00011-6).
- [30] J. Stephenson, B. Barton, G. Carrington, D. Gnoth, R. Lawson, P. Thorsnes, Energy cultures: a framework for understanding energy behaviours, *En. Policy* 38 (2010) 6120–6129, <https://doi.org/10.1016/j.enpol.2010.05.069>.
- [31] B.J. Rygg, Wind power—an assault on local landscapes or an opportunity for modernization? *En. Policy* 48 (2012) 167–175, <https://doi.org/10.1016/j.enpol.2012.05.004>.
- [32] J. Murdoch, T. Marsden, The spatialization of politics: local and national actor-spaces in environmental conflict, *Trans. Inst. British Geogr.* 20 (3) (1995) 368, <https://doi.org/10.2307/622657>.
- [33] P. Siakwah, Actors, networks, and globalised assemblages: rethinking oil, the environment and conflict in Ghana, *Energy Res. Soc. Sci.* 38 (2018) 68–76, <https://doi.org/10.1016/j.erss.2018.01.021>.
- [34] Government Communication and Information System, South Africa Yearbook 2015/2016. <http://www.gcis.gov.za/content/resourcecentre/sa-info/yearbook2015-16>, 2016 (accessed 7 July 2020).
- [35] Project90by2030, Energy sector transformation in South Africa. <https://90by2030.org.za/wp-content/uploads/2017/08/Project-90-Energy-Sector-Transformation-in-SA-study-report.pdf>, 2017 (accessed 7 July 2020).
- [36] DoE, A survey of energy-related behaviour and perceptions in South Africa. <http://>



- www.energy.gov.za/files/media/Pub/Survey%20of%20Energy%20related%20behaviour%20and%20perception%20in%20SA%20-%20Residential%20Sector%20-%202012.pdf, 2012 (accessed 7 July 2020).
- [37] L. Baker, Post-apartheid electricity policy and the emergence of South Africa's renewable energy sector, in: D. Arent, C. Arndt, M. Miller, F. Tarp, O. Zinnaman (Eds.), *The Political Economy of Clean Energy Transitions*, Oxford University Press, Oxford, 2017, pp. 371–390.
- [38] DoE, Electricity regulations on the Integrated Resource Plan 2010–2030. [http://www.energy.gov.za/IRP/2010/IRP\\_2010.pdf](http://www.energy.gov.za/IRP/2010/IRP_2010.pdf), 2010 (accessed 7 July 2020).
- [39] L. Baker, J. Burton, C. Godinho, H. Trollip, The political economy of decarbonisation: exploring the dynamics of South Africa's electricity sector, *Energy Research Centre* <https://sro.sussex.ac.uk/id/eprint/58502/>, 2015 (accessed 7 July 2020).
- [40] C. Yelland, R. Lilly, Where is the Integrated Resource Plan? <https://www.moneyweb.co.za/moneyweb-opinion/where-is-the-integrated-resource-plan/>, 2019 (accessed 7 July 2020).
- [41] DoE, Integrated resource plan update. <http://www.energy.gov.za/IRP/2016/Draft-IRP-2016-Assumptions-Base-Case-and-Observations-Revision1.pdf>, 2016 (accessed 7 July 2020).
- [42] P. Fowles, The Future of Municipal Electricity Distribution in South Africa, Paper presented at the Communication to Industrial & Commercial Use of Energy Conference, 2004.
- [43] Statistics SA, Financial census of municipalities for the year ended 30 June 2014. <http://www.statssa.gov.za/publications/P9114/P9114June2014.pdf>, 2015 (accessed 7 July 2020).
- [44] SALGA, The role of municipalities as a Service Authorities for Electricity provision. <https://www.scribd.com/document/324899964/The-Role-of-Municipalities-as-Electricity-Service-Authorities-Draft2-SALGA-Aug-2014-docx>, 2014 (accessed 7 July 2020).
- [45] Sustainable Energy Africa, State of energy in South Africa's cities, SEA, Cape Town, 2015.
- [46] L. Tait, Targeting informal households: diversifying energy supply for the poor in Cape Town, [http://www.erc.uct.ac.za/sites/default/files/image\\_tool/images/119/Papers-2017/17-Tait\\_Diversifying\\_energy\\_supply.pdf](http://www.erc.uct.ac.za/sites/default/files/image_tool/images/119/Papers-2017/17-Tait_Diversifying_energy_supply.pdf), 2016 (accessed 7 July 2020).
- [47] B. Bekker, A. Eberhard, C. Gaunt, South Africa's rapid electrification programme: policy, institutional, planning, financing and technical innovations, *En. Policy* 36 (2008) 3125–3137, <https://doi.org/10.1016/j.enpol.2008.04.014>.
- [48] P. Dicken, P.F. Kelly, K. Olds, H. Wai-Chung Yeung, Chains and networks, territories and scales: towards a relational framework for analysing the global economy, *Global Networks* 1 (2) (2001) 89–112, <https://doi.org/10.1111/glob.2001.1.issue-210.1111/1471-0374.00007>.
- [49] A. Schaffartzik, A. Brad, M. Pichler, A world away and close to home: the multi-scalar 'making of' Indonesia's energy landscape, *Energy Policy* 109 (2017) 817–824, <https://doi.org/10.1016/j.enpol.2017.06.045>.
- [50] S. Jaglin, Urban energy policies and the governance of multilevel issues in Cape Town, *Urb. Stud.* 51 (2014) 1394–1414, <https://doi.org/10.1177/0042098013500091>.
- [51] W.P. Pauw, Mobilising private adaptation finance: developed country perspectives, *Int. Environ. Agreem.: Politics, Law Econ.* 17 (2017) 55–71, <https://doi.org/10.1007/s10784-016-9342-9>.
- [52] J.K. Musango, Household electricity access and consumption behaviour in an urban environment: the case of Gauteng in South Africa, *Energy Sustain. Dev.* 23 (2014) 305–316, <https://doi.org/10.1016/j.esd.2014.06.003>.
- [53] Statistics South Africa, General Household Survey 2018. <http://www.statssa.gov.za/publications/P0318/P03182018.pdf>, 2018 (accessed 7 July 2020).
- [54] Statistics South Africa, General Household Survey 2016. <http://www.statssa.gov.za/publications/P0318/P03182016.pdf>, 2016 (accessed 7 July 2020).
- [55] A. Blok, Worlding cities through their climate projects? *City* 18 (2014) 269–286, <https://doi.org/10.1080/13604813.2014.906715>.
- [56] G. Walker, A. Karvonen, S. Guy, Zero carbon homes and zero carbon living: sociomaterial interdependencies in carbon governance, *Trans. Inst. Br. Geogr.* 40 (2015) 494–506, <https://doi.org/10.1111/tran.12090>.
- [57] H.S. Brown, P.J. Vergragt, Bounded socio-technical experiments as agents of systemic change: the case of a zero-energy residential building, *Technol. Forecast. Soc. Change.* 75 (2008) 107–130, <https://doi.org/10.1016/j.techfore.2006.05.014>.
- [58] J.J. Bos, R.R. Brown, Governance experimentation and factors of success in socio-technical transitions in the urban water sector, *Technol. Forecast. Soc. Change.* 79 (2012) 1340–1353, <https://doi.org/10.1016/j.techfore.2012.04.006>.
- [59] J.P. Evans, Resilience, ecology and adaptation in the experimental city, *Trans. of the Inst. of Br. Geogr.* 36 (2011) 223–237, <https://doi.org/10.1111/j.1475-5661.2010.00420.x>.
- [60] F. Caprotti, R. Cowley, Interrogating urban experiments, *Urban Geogr.* 38 (2017) 1441–1450, <https://doi.org/10.1080/02723638.2016.1265870>.
- [61] D. Archer, F. Almansi, M. DiGregorio, D. Roberts, D. Sharma, D. Syam, Moving towards inclusive urban adaptation: approaches to integrating community-based adaptation to climate change at city and national scale, *Clim. Dev.* 6 (2014) 345–356, <https://doi.org/10.1080/17565529.2014.918868>.
- [62] E. Chu, I. Angelovski, J. Carmin, Inclusive approaches to urban climate adaptation planning and implementation in the Global South, *Clim. Policy* 16 (2016) 372–392, <https://doi.org/10.1080/14693062.2015.1019822>.
- [63] H. Lefebvre, *The Urban Revolution*, University of Minnesota Press, Minneapolis, 2003.
- [64] M. Huchzermeyer, The legal meaning of Lefebvre's the right to the city: addressing the gap between global campaign and scholarly debate, *GeoJournal* 83 (2018) 631–644, <https://doi.org/10.1007/s10708-017-9790-y>.
- [65] C. Lemanski, Unequal citizenship in unequal cities: participatory urban governance in contemporary South Africa, *Int. Dev. Plan. Rev.* 39 (2017) 15–35, <https://doi.org/10.3828/idpr.2017.2>.
- [66] A. Klotz, Borders and the roots of xenophobia in South Africa, *S. Afr. Hist. J.* 68 (2016) 180–194, <https://doi.org/10.1080/02582473.2016.1153708>.
- [67] D. Brotman, The faces behind SA's citizenship nightmare, *Mail & Guardian*. (2018) <https://mg.co.za/article/2018-07-05-00-the-faces-behind-sas-citizenship-nightmare> (accessed 7 July 2020).
- [68] D. Griggs, M. Stafford-Smith, O. Gaffney, J. Rockström, M.C. Öhman, P. Shyamsundar, W. Steffen, G. Glaser, N. Kanie, I. Noble, Sustainable development goals for people and planet, *Nature* 495 (2013) 305–307, <https://doi.org/10.1038/495305a>.
- [69] K. Bäckstrand, Accountability of networked climate governance: the rise of transnational climate partnerships, *Glob. Environ. Politics* 8 (2008) 74–102, <https://doi.org/10.1162/glep.2008.8.3.74>.
- [70] H. Nagendra, X. Bai, E.S. Brondizio, S. Lwasa, The urban south and the predicament of global sustainability, *Nat. Sustain.* 1 (7) (2018) 341–349, <https://doi.org/10.1038/s41893-018-0101-5>.
- [71] UNFCCC, South Africa's Intended Nationally Determined Contribution. <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/South%20Africa%20First/South%20Africa.pdf> 2016 (accessed 7 July 2020).
- [72] S. Kiratu, South Africa's Energy Security in the Context of Climate Change Mitigation, International Institute for Sustainable Development, Series on Trade and Energy Security, Policy Report 4. [https://www.iisd.org/sites/default/files/publications/south\\_africa\\_energy\\_climate.pdf](https://www.iisd.org/sites/default/files/publications/south_africa_energy_climate.pdf), 2010 (accessed 7 July 2020).
- [73] Department of Environmental Affairs, National Climate Change Adaptation Strategy. [https://www.environment.gov.za/sites/default/files/reports/nationalclimate\\_changeadaptation\\_strategyforcomment\\_nccas.pdf](https://www.environment.gov.za/sites/default/files/reports/nationalclimate_changeadaptation_strategyforcomment_nccas.pdf), 2017 (accessed 7 July 2020).
- [74] G. Ziervogel, J. Waddell, W. Smit, A. Taylor, Flooding in Cape Town's informal settlements: barriers to collaborative urban risk governance, *S. Afr. Geogr. J.* 98 (2016) 1–20, <https://doi.org/10.1080/03736245.2014.924867>.
- [75] L. Baker, J. Burton, The politics of procurement and the low carbon transition in South Africa, in: A. Goldthau, M. Keating, C. Kuzemko (Eds.), *Handbook of the International Political Economy of Energy and Natural Resources*, Edward Elgar, Cheltenham, 2004, pp. 91–106.
- [76] A. Eberhard, R. Naude, The South African Renewable Energy IPP Procurement Programme: Review, Lessons Learned & Proposals to Reduce Transaction Costs, University of Cape Town, Cape Town, [https://www.gsb.uct.ac.za/files/EberhardNaudeREIPPPReview2017\\_1\\_1.pdf](https://www.gsb.uct.ac.za/files/EberhardNaudeREIPPPReview2017_1_1.pdf), 2017 (accessed 7 July 2020).
- [77] A. Eberhard, Towards a secure, competitively priced and environmentally sustainable electricity future, or (The folly of big coal, big nuclear and big networks). <https://www.ee.co.za/wp-content/uploads/legacy/speakers/anton-eberhard-key-note-address.pdf>, 2013, (accessed 7 July 2020).
- [78] DoE, South Africa coal sector report. <http://www.energy.gov.za/files/media/explained/South-African-Coal-Sector-Report.pdf>, nd, (accessed 7 July 2020).
- [79] M. Swilling, E. Annecke, *Just Transitions: Explorations of Sustainability in an Unfair World*, UCT Press, Claremont, 2012.
- [80] D. Geldenhuys, The weak domestic base of South Africa's good global citizenship, *S. Afr. J. Int. Aff.* 22 (2015) 411–428, <https://doi.org/10.1080/10220461.2015.1123648>.
- [81] T. Venturini, Diving in magma: how to explore controversies with actor-network theory, *Public Underst. Sci.* 19 (2010) 258–273, <https://doi.org/10.1177/0963662509102694>.